Strategy of Military Lands Reusing in Lithuania

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The Soviet army left Lithuania in 1993. Upon withdrawal they have left about 500 various military installations. There were 277 Soviet military bases in which 462 military units were located at that time. Sizes of military sites varied in a rather wide scale – from less then 100 m^2 (workshops) to nearly 14000 ha (forestry). Military sites according to their sizes are presented in Table 1. All military sites occupied territories of 67762 ha, which makes 1.04 % of Lithuania's territory. Currently, 16.7 % of the territory has been left to satisfy the Lithuanian military needs and the rest has been transferred to civil users.

Table 1. The distribution of military sites according to their sizes

Area (ha)	Number of bases	Total area (ha)
Less than 1	60	17
1-10	78	309
10-100	80	2718
100-1000	45	13594
1000-10000	13	37262
Over 100000	1	13862
Total	**277**	**67762**

Military sites situated on the territory of the Republic of Lithuanian had served specific purposes - from the establishment of military settlements and military forestry areas to the shooting grounds and military airfields (Table 2). That had significantly impacted upon the scale and character of the environmental pollution and destruction in the occupied territories.

Table 2. The distribution of military sites according to their destination

Type of military site	Number
Motor-rifles units	3
Landing-party units	10
Artillery units	4
Engineering, transport, railway, supply and building units	33
Airfields, aviation units	15
Storage of oil products and rockets fuel	4
Rockets and antiaircraft bases	31
Warehouses	21
Communication units	35
Grounds and shooting-ranges	12
Border troop units	20
The military infrastructure (settlements, schools, hospitals, shops, military forestry, military tribunals)	63
Training and teaching centres	6
Repairing enterprises	4
Tank units	1

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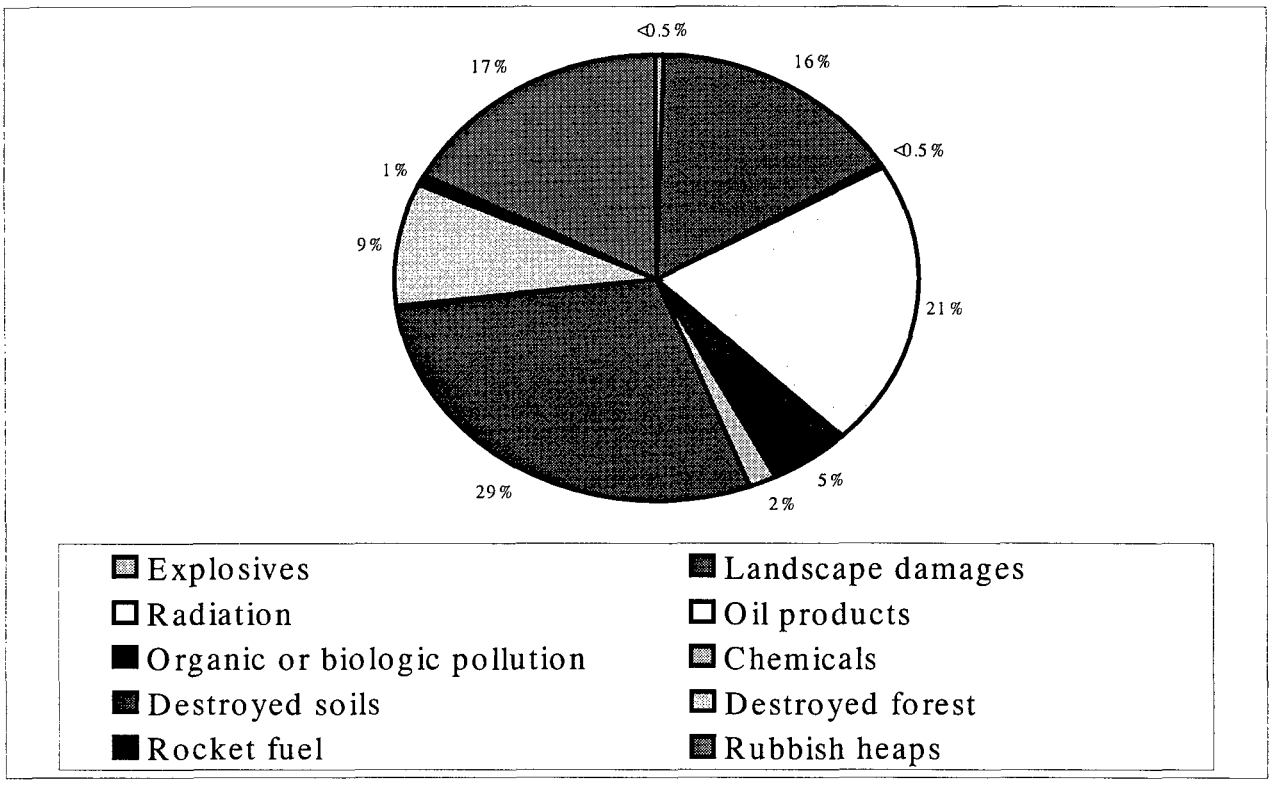
Unites of other types	15
Total:	**277**

When Lithuania overtook the Soviet military bases, an Evaluation Committee comprising local specialists has been established to evaluate environmental situation in the former Soviet military bases. One of the main tasks was to identify effective measures, which applied, could prevent further spreading of pollutants. Lithuanian experts recorded 2743 sources of the actual pollution in the former military lands (Tables 3, 4). We can see in Table 5 that only in 14% of all military bases did not contain pollution sources. However, the remainders of 200 types of poisonous chemical substances have been found in the rest 86% of the former Soviet military sites. Many different flammable materials have been also left in those territories. Ruins of the former buildings and other sources of potential danger are present almost in every military site.

Table 3: sources of the actual pollution in former military lands



As we can see from the above-mentioned numbers, pollution caused by oil products and rubbish-heaps prevailed in the military sites as well as the landscape and soil damages. 478 rubbish-heaps were found in the military sites, which makes 17 % of all environmental damages. There are about 333000 m^3 of waste in 1188 ha of the polluted territory. The main waste originates from buildings and metal scrap which amounts to 96000 m^3, military activity waste makes 88000 m^3, mixed household waste roughly equals to 84000 m^3 (Tables 6, 7). Streams of waste water and wind transport heavy metals particles, oiled dust, bitumen and other break-up products from rubbish-heaps into the clean sites. Natural ecosystems have been severely affected by the log-term military activity in the restricted military sites and they cannot be easily restored, sometimes causing harm to the health of inhabitants of those territories. The main problem of reusing military sites therefore at this time is the prevention of pollution being spread further, and

specifically, immediate localisation and liquidation of those pollution sources which raise direct danger for human health and environment.

Table 4: Types of territories damages and their distribution

Type of fixed damages	Quantity*	Area (ha)
Explosives	12	DC**
Landscape damages	438	7140
Radiation	9	DC
Oil products	566	399
Organic or biologic pollution	137	14
Chemicals	56	DC
Destroyed soils	778	11137
Destroyed forest	249	3293
Rocket fuel	20	DC
Rubbish heaps	478	1288
Total	**2743**	**23271**

* - Number of pollution sources.
** - Dotted concentration.

Table 5: Distribution of pollution sources

Quantity of pollution sources in military site	Quantity of territories	Total number of pollution sources
No one	41 (14%)	0 (0%)
1-5	94 (35%)	268 (10%)
6-10	59 (21%)	447 (16%)
11-20	50 (18%)	750 (27%)
21-50	27 (10%)	840 (31%)
More than 50	6 (2%)	438 (16%)
Total	**277 (100%)**	**2743 (100%)**

* - Number of rubbish-heaps.

Having estimated the results of research of environmental situation in the military sites, the latter territories have grouped according to their level of investigation and the necessity of preventative measures, clean-up and restoration works. In addition, every territory has been grated a certain category according to the listed criteria. The categories are described by indexes A, B, C, D, E, F (from the highest damages to the least). Every military site has received an index consisting of two letters (for example, BC). Here the first letter describes the level of investigation and the necessity of researches or preventative and cleaning works, the second letter means the level of the landscape destruction and the necessity of restoration works. Only one former military territory is ascribed to A category, namely Šiauliai airfield, however territories, which, according to pollution level, are ascribed to B, C and D categories, make about 80% of all former military sites. Similar situation remains in the field of landscape destruction.

Table 6: The main types of wastes in military landscapes

Types of wastes	Quantity*	Thousands m^3

Building/metal scraps	157	96
Ruins	50	25
Waste of military/economic activity	182	88
Mixed industrial waste	17	35
Mixed household waste	65	84
Other	7	5
Total	**478**	**333**

* - Number of pollution sources.

Table 7: Types of rubbish-heaps and total area

Types of waste	Quantity*	Area of accumulation (ha)
Polluted area by waste or litter	272	1120
Rubbish-heaps and ruins	168	56
Waste-heaps	38	12
Total	**478**	**1188**

Despite of their future utilisation the following preventative measures are being applied:

a) removal of radioactive pollution sources,
b) removal of explosives,
c) isolation and removal of oil pollutants,
d) removal of aggressive waste and scrap,
e) neutralisation and removal of chemicals.

Landscape renovation may be divided into three main stages:

1) preventative,
2) curative,
3) reconstruction.

Preventive works are considered to estimate the danger raising from military sites and pollution migrations and to stop dispersion of explosives or dangerous materials. These measures are to predetermine the nature of protection systems and regimes to be established in those territories.

Curative actions include almost all means of prevention and cleaning of the territory from pollutants and other dangerous and explosive materials. Also, territory restoration in most cases foresees arrangement of buildings, full or part re-creation of the entire relief, green plantations and restoration of the soil layer. Reconstruction of territory is its analysis with regard to pre-military use and works directed to complete restoration of the former environmental situation.

Restoration of a military site is a complex renewal of degraded grounds, rebuilding of economical, ecological, esthetical and other values. Engineering and biological stages of reconstruction works are included. The engineering stage is the primary preparation of the site for future uses (drawing disturbed surface, forming slopes, transporting and spreading new active ground to areas under reconstruction, building roads and hydrotechnical installations, etc). The biological stage includes the agro-technical phytoland replanting and restoration of productivity of renovated surface by engineering means.

First preventative works, which have been done in all military sites, were the removal of all sources of radioactivity and explosives from the areas. All radioactive pollutants found on the territories have been moved to the special dumping site. Radioactive pollution is therefore hardly probable at present. A few separate sources of radioactive emanation might be still detected in territories where devices or their parts contaminating radiation had been stored.

According to the prepared classification, military sites and individual objects in which preventative and clean-up works have to be carried out first have been selected. Works initially shall start in the Šiauliai airfield. A renovation project has been prepared and works have started. Its is the most polluted and damaged military site in Lithuania. Presently, the Danish company Krüger Int. Consult A/S in co-operation with the "Baltic Consulting Group" Ltd carries out cleaning works by extracting free oil products' accumulations from ground water surface using hydrodynamics method with oil skimming on the territory of the former fuel base at the airport.

Preventative work programmes based on the principle that pollution sources must be removed first in order to stop further pollution of grounds are being developed. The ground polluted with oil products is considered as a secondary source of pollution. According to the existing requirements of directive LAND 9-95, industrial activity in territories polluted with oil products is permissible only when the concentration of oil products in the ground is less than 2000 mg/kg. This concentration in the Siauliai former military airport ground varies from 2000 mg/kg tol 5000 mg/kg.

Similar project is being prepared for the former rocket base in Taurage. Currently, preventative cleaning is on-going and technical project design is being prepared. In total, 10 military sites have been investigated in detail to date, based on which results, new projects related to ecological optimisation and renovations for other territories will be prepared. They suggest what pollution preventative works must be carried out immediately in other territories. Such territories have been selected in different Lithuanian areas so that they reflect types of pollution and typical landscape damages that could be seen. Newly developed projects will include renovation of those territories, and other former military sites will be managed in the future.

In all territories where groundwater cleaning works are being carried out, there is a requirement that water after cleaning must comply the drinking water standard requirements. This principal requirement applied in the process of removing all types of pollutants determines the selection of cleaning measures and technologies.

Monitoring as one of main preventative measures is obligatory for both surrounding of cleaning sites and sources isolated and protected from spreading pollution. In some cases monitoring helps observe the cleaning process and evaluate the level of cleaning, but it is not obligatory after the end of cleaning works. In other cases, monitoring lasts 10-20 years and foresees observations of the process of spontaneous self-reclining and an assessment of danger of pollution spreads and timely blockage of their ways. In the Šiauliai airfield, Vilnius "Northern borough" and some other former military sites such monitoring is on-going.

At present, some former military sites are being used by civil society to some extent. The airports in Šiauliai (Zokniai) and Karmelava (Kaunas) are being reorganised in free economical zones. The new functions are being taken to develop business in Kedainiai airport.

The majority of military sites, which are located in urban zones, are assigned for living or industrial sector. Ecological optimisation of the territory requires an agreement on its functions. They must be functionally related with contiguous territories. In such territories the following sequence of works as preventative measure against future pollution spread is being designed: all sources of pollution should be removed from surface and priority zones of greenery formed. They could make barriers for streams of pollutants and individual businesses – industrial zones from living territories and in this way to improve environment at living zones.

It is expected to create a modern business centre in Vilnius "Northern borough". This big military site is located in the centre of Vilnius City and has very important value for future Vilnius development. Radioactive and oil pollution sources have been removed from there. Groundwater monitoring is being carried out in this military site. Various enterprises and government institutions have settled in the former military barracks. In future, it is foreseen to

pull down those barracks and to rebuild the whole territory in modern style. It is expected to realise the project in 10-15 years.

Having removed pollutants, a centre for illegal immigrants has been opened in Pabrade former military site. "Rukla" military borough, which is between the Jonava and Kaunas cities, was adapted for living ward. Aggressive sources of pollution have been removed, new communication lines have been laid and now few thousand inhabitants live there and continue working in Kaunas, Jonava or surrounding regions.

University of Klaipeda has been settled in the former military barracks of the Klaipeda city. In Nemencine centre of radio-reconnaissance the environmental education centre has appeared. Various enterprises have settled in some smaller military bases. It does not however mean that environmental situation in those military sites is friendly. Only first steps towards their renovation have been made and it needs to be built upon by carrying out full ecological investigation in the nearest future. Besides that, there is an outstanding problem that the majority of military objects in which valuables were stored or equipment that would have been suitable for business were destroyed and building ruined.

Clean-up and re-utilisation of former military sites is identified as persisting problem. Ministry of Defence has overtaken about one third of former military territories, but it is not in a position to take care of all its territories properly. Better situation is observed in former military forestry. The Ministry of Defence together with the Ministry of Environment and environmentalists from other institutions have listed twenty priority military sites, which need to be renovated as possibility arises. A Special Group has been created comprising environmental, economical, law and other specialists representing concerned institutions. The Group is charged with the task to prepare proposals concerning future renovation of former military sites.

A Joint Committee is currently being created by the Ministry of Environment and the Ministry of Defence. Its function will be to organise preventative activity in military sites, which now are used by Lithuanian soldiers. The Committee shall prepare methodology for resolving environmental protection problems working military sites in order to prevent the creation of new pollution sources. Scientists from Vilnius Gediminas Technical University, Geographical, Geological, Ecological, Physics and other institutes usually carry out field and laboratory researches to estimate and control environmental situation in military sites. The direct result of scientific researches is the preparation of optimal scenarios for renovation and reusing of the former military sites.

Future necessity of military sites renovation is determined by three general aspects:

1) scale of pollution and environment destruction,

2) danger caused to human health and environment,

3) the perspective of their future usage.

For future restoration all territories are divided into several groups:

1) territories which do not cause danger for human beings or environment and in future, will be used for military purpose;

2) territories which do not cause danger for human beings or environment at present but in future using the sites for military purposes, the some problems can arise again;

3) territories, which cause danger for human beings or environment and in future they are planed to be used for military purposes;

4) territories which do not cause danger for human beings or environment and in future will be used for civil purposes;

5) territories which do not cause danger for human beings or environment at present but in future even not using the sites for military purposes the problems can persist;

6) territories which are causing danger for human beings or environment and in future are planned to be used for civil purposes;

A landscape renovation plan must be developed for every military territory or its part according to the above-listed site utilisation aspects.

Renovation of military landscape includes:

a) arranging for restoration of damaged surface, making forms near to natural landscape;
b) cleaning polluted sites and removing pollutants and waste;
c) re-naturalisation.

Preparing a renovation project for military site, legal documents for future usage of the site are required and zoning of the whole territory for future usage must be done. Renovation can also be done in those damaged territories, which are foreseen for military purposes.

Depending on territory future utilisation new renovation projects describe:

a) renovation level,
b) renaturalisation degree.

Territory's location and its future usage determine the level of renovation. The following measures of renovation are planned independently of the future usage:

a) removal of explosives,
b) removal of waste and scrap,
c) neutralisation and removal of chemicals,
d) removal of s of radioactive pollution source,
e) removal of erosion sources.

Territories allocated for replanting forests need additional measures:

a) searches of explosives and their removal from the depth not less than 1.5 m,
b) surface drawing in medium and strongly damaged grounds and quarries.

Necessary additional measures for the territories foreseen for agricultural development:

a) drawing of all damaged ground,
b) active ground level forming,
c) investigating and projecting land-reclamation of the territories.

Two levels of territory cleaning from pollutants are indicated (Table 8):

The first level is applicable to sites, which are used for settling down, intensive recreation, also for water protective zones, sanitary zones of water places, for all carst territories.

The second level is applicable for sites used for other (economic and military) purposes.

Renovation projects foresee the clean-up of polluted ground and formation of natural cleaning conditions.

Table 8. Maximal permissible levels of cleaning pollutants in territories mg/kg

Pollutants	I category	II category
Oil products*	300	1000
Pb	100	600
Cd	2	20
Cr	150	800
Cr(VI)	25	100
Co	100	300
Cu	200	600
Ni	200	300
Hg	0,5	10
Zn	500	3000

* For inhabitants, water protection and sanitary zones – 20 mg/kg.

The renovation of the landscape's stability is a complex of reconstruction measures forming natural varieties, which must create the conditions for spontaneous natural renovation of natural complexes in the cultivated parts of the territories.

In territories where renovation is foreseen, natural level of water is restored by technical means, new conditions are created for natural communities of plants and formations of animal populations and restoration of greener cover.

Natural complexes or their fragments formed during renovation have larger natural variety than antropogenic complexes; they are more resistant for negative antropogenic activity and more effective for retaining of landscape's stability.

Scenarios of ecological optimization are created according to the restoration and optimization of typical military sites. According to the plan of optimization and renovation, first problems are indicated of cartographic localization of main works and establishment of renovation costs.

In military sites, existing in uninhabited districts, first it must be attempted to renovate the territories according to its usage and saving ecological stability of the object.

In all cases when projects of renovation of military landscape are prepared, the cleaning polluted ground or conditions for natural re-cleaning are foreseen. In those cases when there are not any spreading sources of pollutants, the main measures for tiding soiled territories are to remove waste and ruins from military and adjacent sites. Aggressive waste must be transported into specially arranged and steadily observed landfills. Those ruins of buildings and equipment, which can be rebuilt or used in future should not be destroyed.

In the meanwhile, the works on sanation of the territories are almost not done (only for a couple of the largest military bases the sanation projects are being prepared by foreign expenses). At present it is not absolutely clear, who must take care of arrangement of the soiled and damaged territories. The Government, by its decision, obligated the landowners or their tenants to make those works, therefore they are not interested to invest great sums of money for cleaning the Soviet "heritage", because they are not the owners and they have not enough capital for this.

The renovation of military sites in Lithuania demands effective, expensive and urgent sanation-restoration measures. Lithuanian researches steadily take care of environmental situation in military sites. Scientists from main scientific institutes carry out common works in this direction. We hope that co-operation between different Lithuanian institutes of scientific researchers together with business enterprises and Government institutions and partnership intercourse with foreign specialists will help us more faster and more effectively to solve renovation problems.